



Replacement of pixel detector in phase 1

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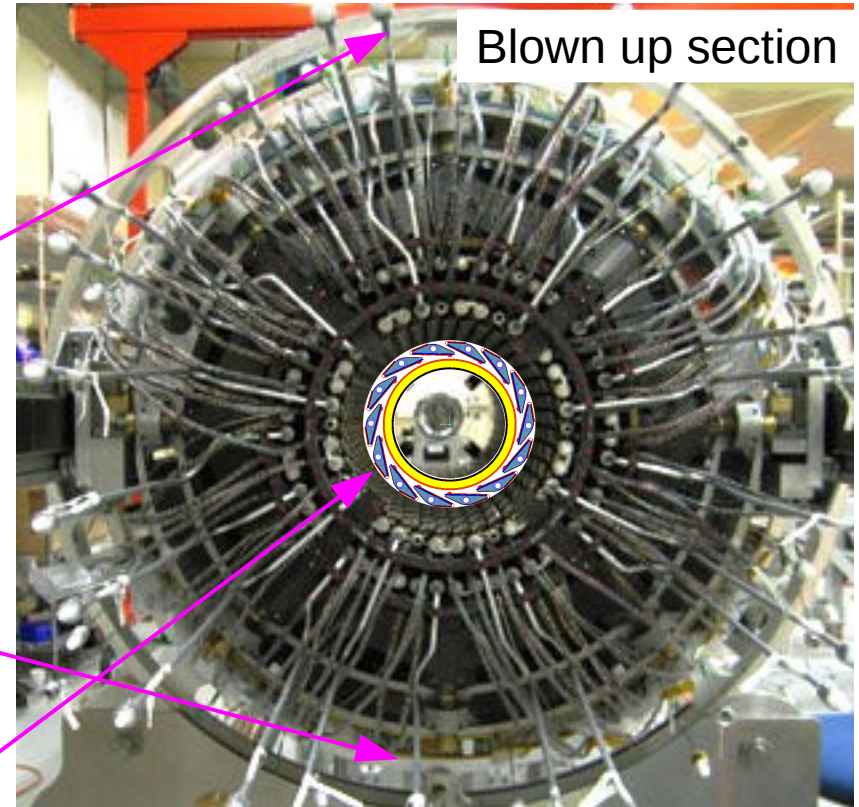
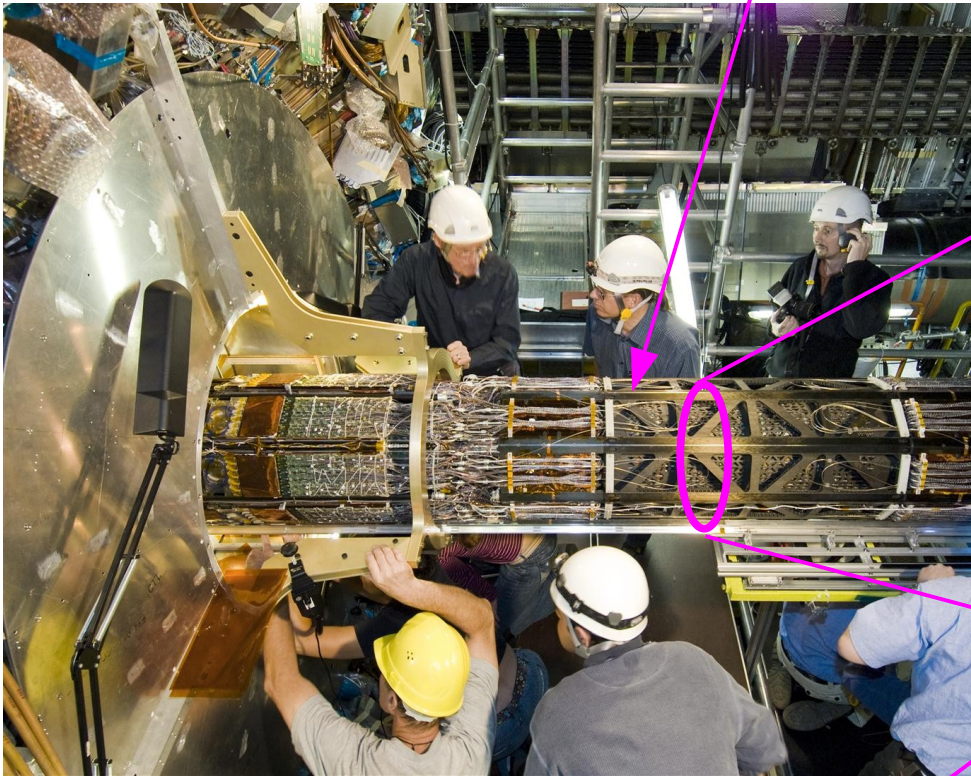


Overview

- What is it?
- Why is this being considered?
- Decision timeline
- What it is in a little more detail
- Potential cost and US budget profile

What is it?

Replace this (slides out of Inner Detector)



Not this (IBL on new beam pipe)



Why?

- Serious consideration spurred by two recent developments:
 - (1) the success of the FE-I4 integrated circuit development (a US-led activity), and
 - (2) the decision to extend the present LHC running through 2012, which pushes the Phase 1 shutdown later.
- These make it technically feasible to build a replacement detector with new technology
- To decide if it is desirable (not just feasible), ATLAS must answer the question:
 - Does a more advanced pixel detector improve the physics reach?
- Simulation work is now starting to quantify the expected gains in the physics program.
 - Expect results by the Summer and ATLAS to be able to make a decision by end of 2011.

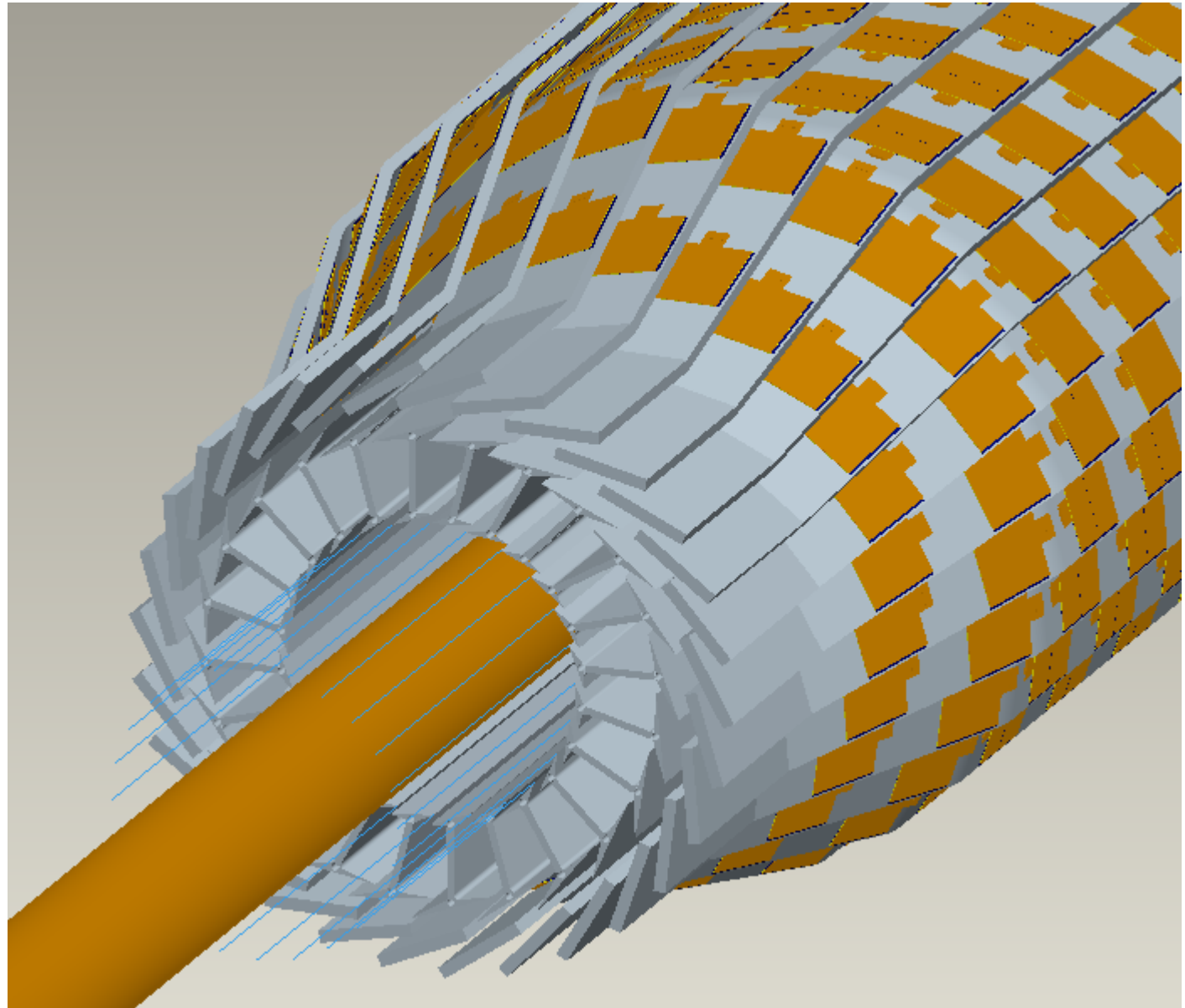


Why? (continued)

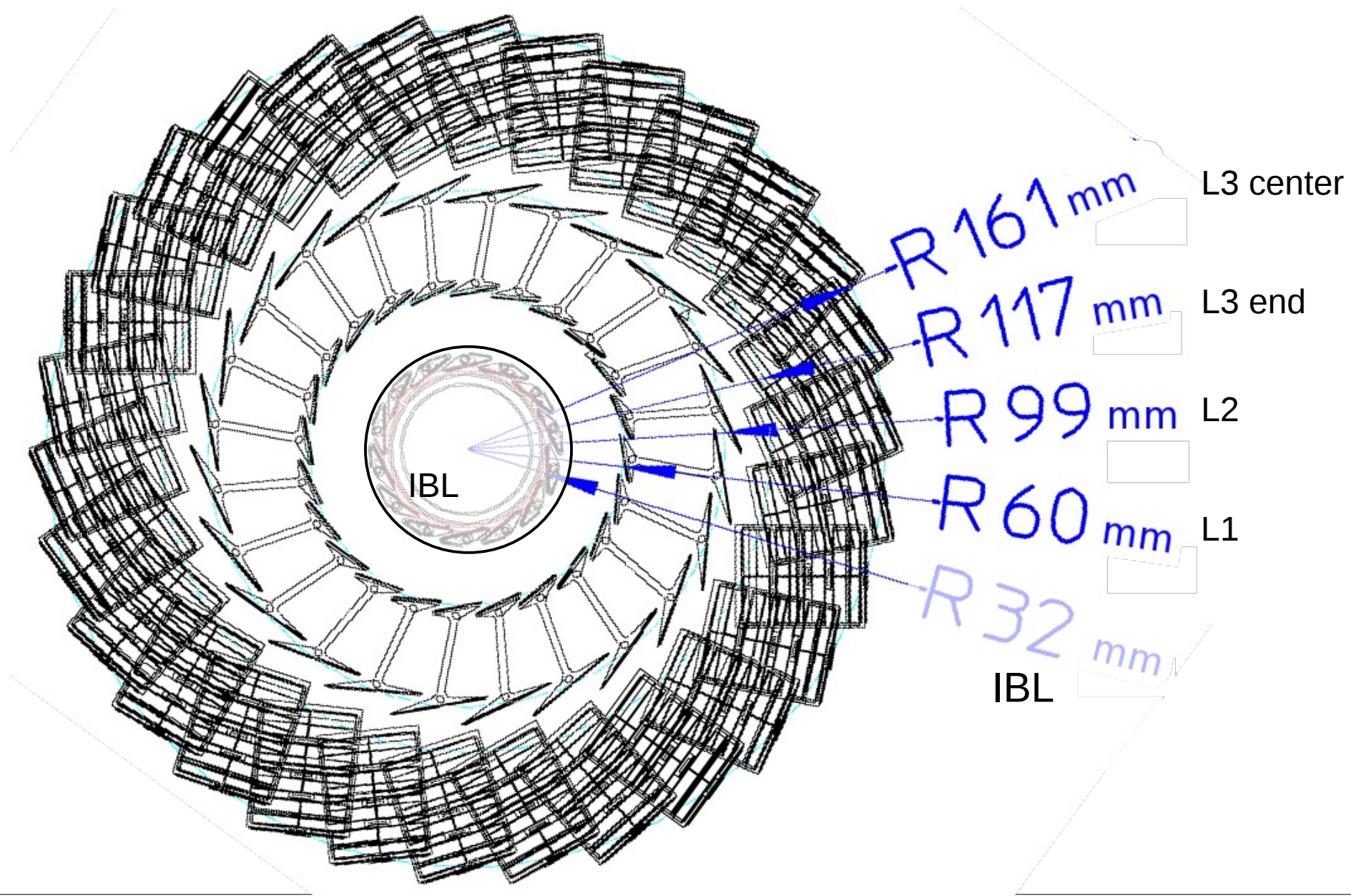
- The pixel detector MUST be replaced eventually.
 - **If** the new has better performance than the old, then the earlier the replacement is made the greater the physics gain.
- Proposed technology for new detector is the technology that we have been developing for phase 2.
 - Development has made “best case”, rather than “typical” progress
 - This is not a compromise of the planned phase 2 technology
- Layout of phase 2 detector with an independent inner pixel part must be studied. This is different from the original phase 2 concept.

More detail on design

No disk design
using “bent staves”
Inspired by Babar
Detector.
Achieves low mass
in forward regions

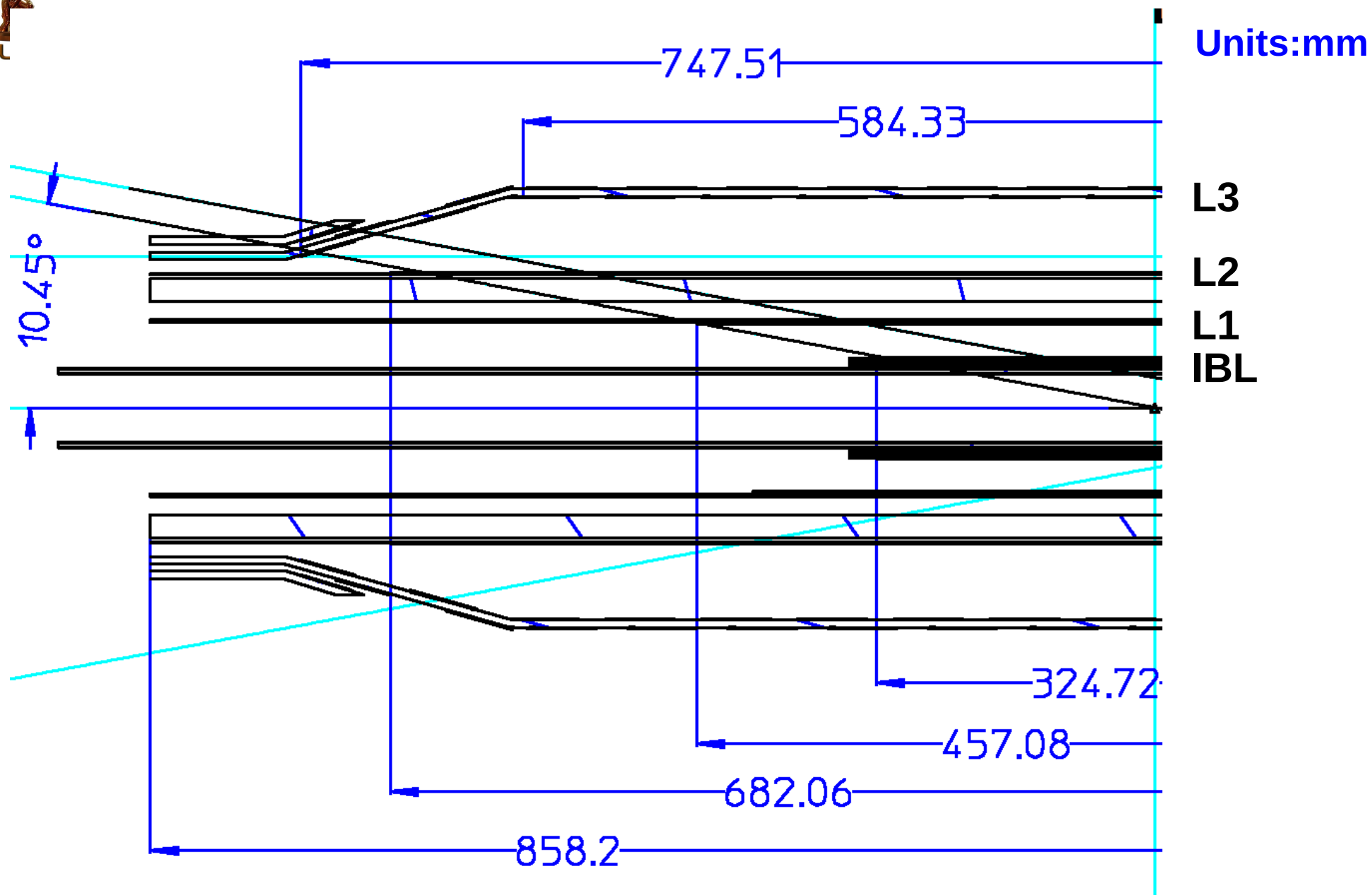


R-Phi view





R-Z view



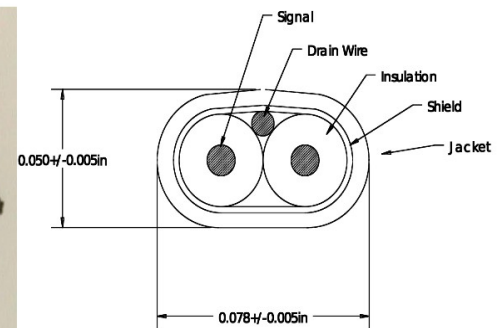
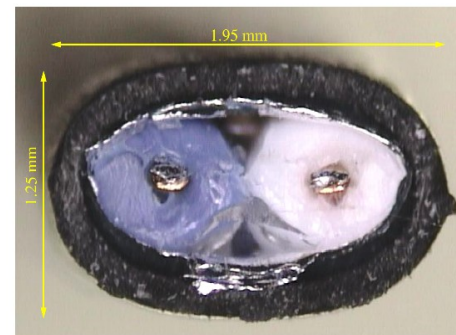
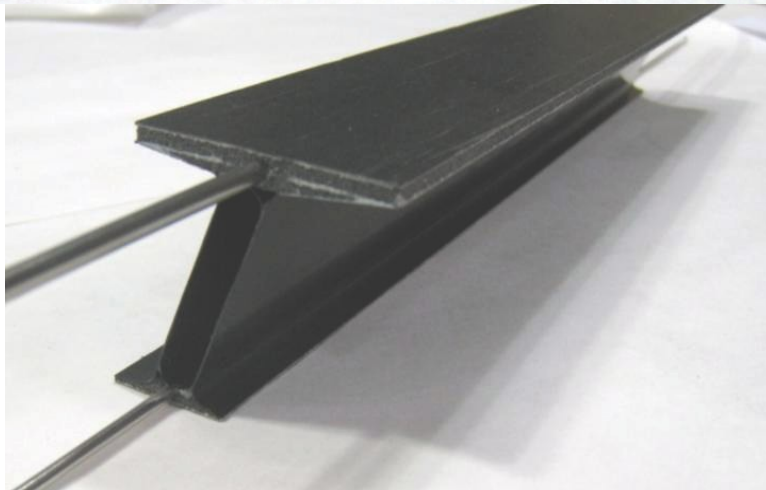
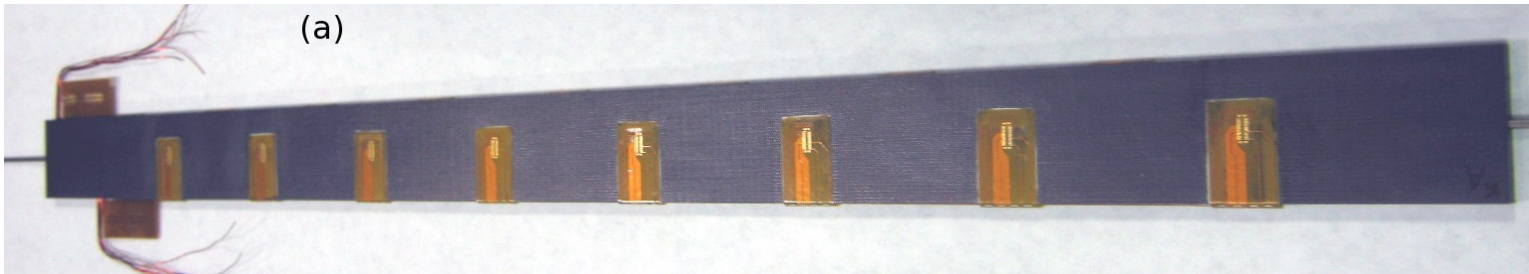


Design uses newly available technology

All components have been prototyped or soon to be prototyped

- FE-I4 IBL-style modules and 4-chip modules
- Planar sensors
- Bent pixel outer staves and straight I-beam staves
- CERN's GBT data transmission system with micro-twinax cables (SLAC)
- SLACs RCE DAQ system

(a)





Cost estimate

- This is the CERN-style “core cost” with contingency
- US share would be at the ~20% level: ~3M
- Mix of common funds and in-kind contributions.

	Production KCHF with yield and spares	Uncertainty scale factor	Basis
FE-I4	1841	1.1	IBL order
Sensors	1380	1.1	HPK estimate, thinned
Bump bonding	1575	1.2	IBL prototypes
flex hybrids	357	1.5	guess
L3 bent staves	259	1.5	vendor budgetary quote
L1+L2 I-beams	109	1.5	Materials for LBL in-house
global frame	500	1.5	original pixel frame
EOS cards	96	2	guess
Optical boards	500	2	Guess – need better from versatile link group
Internal services	1000	1.5	NSQP estimate from Beniamino
External cables, fibers, PP2	453	2	guess
C02 plant and pipes	975	1.2	Scaling of IBL plant- need better estimate
RCE DAQ system	645	1.5	SLAC estimate
DCS system	900	1.2	Estimate by S. Kersten
HV supplies	723	1.2	scaled IBL by number of HV channels
LV supplies	183	1.2	scaled IBL by number of modules
Total with scale factor (KCHF)	15173		



Cost example

- One of the goals of the new FE-I4 integrated circuit was to significantly reduce pixel detector cost (in order to make larger detectors affordable).
- Easy to calculate value of bump bonding in the installed detector (this is for illustration: does not include production yield and spares)
 - Flip-chip bump bonding cost for present detector was 80EUR/FE-I3 chip in large quantity
 - For the very first FE-I4 chips we're now paying 100EUR/FE-I4 chip.
 - Scaling to the full detector:
 - Present detector bump bonding value = 2.2MEUR
 - 1744 modules, 80M pixels, $<2\text{m}^2$
 - New pixel detector bump bonding value = 0.9MEUR
 - 2592 modules, 240M pixels, $>3\text{m}^2$



US Labor

- US construction labor estimate based on likely deliverables
- Areas of US unique expertise and key contributions to technology:
 - IC design
 - Low mass mechanics
 - Data transmission and acquisition
 - Sensors and module design and testing

Item	FTE-yr Engineer	FTE-yr technician	Labor cost FY12k\$	M&S + travel FY12k\$
IC design and test	0.7	0.25	285	50
Mechanical structures	2.5	2	973	150
Installation	1	3	750	375
Electrical Services	2	1.5	762	150
Module assy. Test & irradiation	1.5	1.5	411	50
Data acquisition	2	1	384	50
Pre-production estimate			422	67
subtotal	9.7	9.25	3565	825
Combined total escalated to At Year k\$	5417			

Escalated assuming pre-production in FY14 and installation in FY18



Conclusion and Timeline

- Future of this option depends on potential gains for the physics program. Simulations to valuate this just starting.
- Construction would be a 4 year project:
- In schedule shown today Pre-production would be in FY14.
- And Construction would go from FY15 to installation in FY18.
- Start time is tied to installation of IBL, with resources coming off IBL moving into new project